New Hampshire Volunteer Lake Assessment Program

2003 Interim Report for French Pond Henniker

NHDES
Water Division
Watershed Management Bureau
29 Hazen Drive
Concord, NH 03301

New Hampshire Department of Environmental Services

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **FRENCH POND, HENNIKER,** the program coordinators have made the following observations and recommendations:

Thank you for your continued hard work sampling the lake/pond this season! Your monitoring group sampled **three** times this season! As you know, with multiple sampling events each season, we will be able to more accurately detect changes in water quality. Keep up the good work!

We would like to encourage your monitoring group to participate in the DES Weed Watchers program, a volunteer program dedicated to monitoring the lakes and ponds for the presence of exotic weeds.

Weed Watchers only involves a small amount of time during the summer months. Volunteers survey their waterbody once a month from June through September. To survey, volunteers slowly boat, or even snorkel, around the perimeter of the waterbody and any islands it may contain. Using the materials provided in the Weed Watchers Kit, volunteers look for any species that are of suspicion. After a trip or two around the waterbody, volunteers will have a good knowledge of its plant community and will immediately notice even the most subtle changes. If a suspicious plant is found, the volunteers will send a specimen to DES for identification. If the plant specimen is an exotic, a biologist will visit the site to determine the extent of the problem and to formulate a plan of action to control the nuisance infestation.

If you would like to help protect your lake or pond from exotic plants, contact Amy Smagula, Exotic Species Program Coordinator, at 271-2248 or visit the Weed Watchers web page at www.des.state.nh.us/wmb/exoticspecies/survey.htm.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

  Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 mg/m^3.**

  The current year data (the top graph) show that the chlorophyll-a concentration ***increased slightly*** from July to August. The chlorophyll-a concentration in July and August was ***slightly greater than*** the state mean. (Please note that the June chlorophyll sample was rejected for analysis since it was not a true composite sample.)

  Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a variable*** in-lake chlorophyll-a trend. Specifically, this means that the chlorophyll concentration has ***fluctuated,*** but has *not continually increased or continually decreased*, since monitoring began in 1989. In the 2004 annual report, we will be conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began.

  While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

  Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

  The current year data (the top graph) show that the in-lake transparency ***decreased gradually*** from June to August. The transparency on each sampling event was ***less than*** the state mean. It is important to point out that as the chlorophyll concentration *slightly increased* from July to August, the transparency *slightly decreased*. We typically expect this *inverse* relationship in lakes. As the concentration of algal cells in the water column increases, the ability for light to penetrate into the water column (and consequently the ability to see into the water column) decreases.

  Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a variable*** trend for in-lake transparency. Specifically, the mean annual transparency has ***fluctuated between approximately 1.7 and 3.7 meters*** since monitoring began in 1989. As discussed previously, in the 2004 annual report we will conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

  Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

  Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

  The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***increased greatly*** from June to July, and then ***decreased greatly*** from July to August. The phosphorus concentration on each sampling event was ***greater than*** the state median.

  The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***increased greatly*** from June to July, and then ***remained stable*** from July to August. The phosphorus concentration in June was ***approximately equal to*** the state median, while the concentration in July and August was ***much greater than*** the state median.

  It is important to point out that the turbidity of the hypolimnion (lower layer) sample was elevated on the **July** and **August** sampling events (21.1 and 29.7 NTUs respectively). This suggests that the lake/pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling. When the lake/pond bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the hypolimnion sample, please check to make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

  Overall, visual inspection of the historical data trend line for the epilimnion show a ***relatively stable*** phosphorus trend, which is ***slightly greater than*** the state median.

  Overall, visual inspection of the historical data trend line for the hypolimnion shows a ***highly variable*** phosphorus trend, which is ***much greater than*** the state median.

It is also important to point out that the phosphorus concentration in the hypolimnion has typically been ***much greater than*** the phosphorus concentration in the epilimnion. This data indicates that ***internal total phosphorus loading*** is occurring in the hypolimnion. (Please refer to the discussion of Table 9 and 10 for a detailed explanation of internal total phosphorus loading.)

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**

Table 2 (Appendix B) lists the current and historic phytoplankton species observed in the lake/pond. The dominant phytoplankton species observed this year were ***Ceratium*** **(a dinoflagellate),** ***Anabaena*** **(a cyanobacteria),** ***and Tabellaria*** **(a diatom).**

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the lake/pond, or that the ecology is out of balance. Certain species of cyanobacteria, including ***Anabaena***, can be toxic to livestock, pets, wildlife, and humans.

Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur. During September of 2003, a few lakes and ponds in the southern portion of the state experienced cyanobacteria blooms. This was likely due to nutrient loading to these waterbodies. As mentioned previously, many weeks during the Spring and Summer of 2003 were rainy, which likely resulted in a large amount of nutrient loading to surface waters.

The presence of cyanobacteria serves as a reminder of the lake's/pond's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake/pond by eliminating fertilizer use on lawns, keeping the lake/pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake/pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to "pile" cyanobacteria into scums that accumulate in one section of the lake/pond. If a fall bloom occurs, please contact the VLAP Coordinator.

- **Table 4: pH**
Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean pH at the deep spot this season ranged from **6.44** in the hypolimnion to **6.99** in the epilimnion, which means that the water is ***slightly acidic.*** In addition, when organic matter is decomposed near the lake bottom, acidic by-products are produced, which likely explains the lower pH (meaning higher acidity) in the hypolimnion.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

- **Table 5: Acid Neutralizing Capacity**
Table 5 (Appendix B) presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean ANC value for New Hampshire's lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) this season was **8.27 mg/L**, which indicates that the lake/pond is ***highly sensitive*** to acidic inputs (such as acid precipitation).

- **Table 6: Conductivity**

Table 6 (Appendix B) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire's lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The conductivity has ***increased*** at the **deep spot** of the lake/pond since monitoring began. In addition, the conductivity in **Cow Brook**, **Launch Brook**, and the **Outlet** has also ***increased***. Furthermore, the conductivity in **French Brook** has continued to ***remain high*** since monitoring began.

Typically, sources of increasing and elevated conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity.

We recommend that your monitoring group conduct stream surveys and storm event sampling along the inlet(s) with elevated conductivity so that we can determine what may be causing the increases.

In addition, we recommend that your monitoring group conduct a shoreline conductivity survey. This survey may help to pinpoint sources of elevated conductivity around the pond.

For a detailed explanation on how to conduct rain event and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic Article", or contact the VLAP Coordinator.

For a detailed explanation on how to conduct a shoreline conductivity survey, please contact the VLAP Coordinator

- **Table 8: Total Phosphorus**
  Table 8 (Appendix B) presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The total phosphorus concentration continued to be ***elevated*** in **Cow Brook, French Brook, and Launch Brook** this season. These stations have had a history of ***elevated*** and ***fluctuating*** total phosphorus concentrations.

- **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**
  Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The dissolved oxygen concentration was ***greater than*** **100 percent** saturation at **1.0, 3.0, and 4.0** meters on the **July** sampling event. Layers of algae can raise the dissolved oxygen in the water column since oxygen is a by-product of photosynthesis. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column.

  The dissolved oxygen concentration continued to be ***low in the hypolimnion*** at the deep spot of the lake/pond this season. As stratified lakes/ponds age, oxygen becomes ***depleted*** in the hypolimnion (the lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment.

During this season, and many past sampling seasons the lake/pond has had a lower dissolved oxygen concentration and a higher total phosphorus concentration in the hypolimnion (the lower layer) than in the epilimnion (the upper layer). These data suggest that the process of ***internal phosphorus loading*** is occurring in the lake/pond. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion **(as it was this season and in many past seasons)**, the phosphorus that is normally bound up with metals in the sediment may be re-released into the water column. Depleted oxygen concentration in the hypolimnion of thermally stratified lakes/ponds typically occurs as the summer progresses.

Internal phosphorus loading may explain why the phosphorus concentration in the hypolimnion is ***greater*** than the phosphorus concentration in epilimnion. Since an internal source of phosphorus in the lake/pond may be present, it is even more important that watershed residents act proactively to minimize external phosphorus loading from the watershed.

- **Table 11: Turbidity**
  Table 11 (Appendix B) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

  As discussed previously, the turbidity of the hypolimnion (lower layer) sample was ***elevated*** on the **July** and **August** sampling events. This suggests that the lake/pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling. Please check to make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

- **Other Observations/Investigations:**
  In 2001, the Henniker Conservation Commission received a NHDES Local Watershed Initiative Grant to quantify the tributary phosphorous loading to French Pond. In 2001, the Conservation Commission and French Pond Association (FPA) collected phosphorus samples on a bimonthly basis from French Brook, Launch Brook (2 stations), Cow Brook (4 stations), the Outlet, and the deep spot. Storm event samples were also collected in 2001 and 2002.

  The FPA also conducted a survey to document the status of residential septic systems located near French Pond. The forthcoming final project report will summarize the hydrologic and limnological results of the study and will present a detailed phosphorus budget that incorporates tributary loading and internal cycling of phosphorus in French Pond.

Elevated phosphorus levels in storm event samples collected on Cow Brook reinvigorated efforts to implement Best Management Practices at Porkside Farm. The Farm has approximately eight to ten sows with another 100 pigs of various sizes. The New Hampshire Department of Agriculture, NHDES, and the Natural Resources Conservation Service (NRCS) worked with the landowner to develop a conservation plan for the farm in 2001.

In the Fall of 2002, pigs were fenced out of areas near Cow Brook and site work for a manure pit was completed. In 2003, NRCS designed and assisted with the construction of a manure pit. Photo 1 shows the site work necessary prior to the manure pit construction. The concrete manure pit (which is 26 feet by 60 feet) and ramp can hold approximately 2,880 cubic feet of manure, which allows for approximately five months of manure storage. Photo 2 shows the completion of the manure pit.

DES compliments both the landowner and NRCS for their cooperative efforts to complete the manure pit. Continued sampling of this area will help DES evaluate the Best Management Practices for phosphorus reduction. In 2004, additional paddock areas will be established at the farm for rotating the animals and to reduce heavy land use impacts.

Photo 1: Site preparation for manure pit construction at Porkside Farm

Photo 2: Constructed manure pit construction at Porkside Farm (under snow cover, Dec. 2003)

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your lake/pond, the biologist conducted a “Sampling Procedures Assessment Audit” for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor’s Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an ***excellent*** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures. Keep up the good work!

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did a ***very good*** job when collecting samples this season! Specifically, the members of your monitoring group followed the majority of the proper field sampling procedures when collecting and submitting samples to the laboratory. However, the laboratory did identify a few aspects of sample collection that the volunteer monitors could improve upon. They are as follows:

- **Sample Labeling:** Please make sure to label your samples with a ***waterproof*** pen (a black sharpie permanent marker works best), preferably before sampling. Make sure that the ink does not wash off the bottle when exposed to water. If your association has made its own sample bottle labels, please make sure to fold over one corner of each label before placing it on a sample bottle so that the label will not become permanently attached to the bottle. In addition, please make sure that the labels will stick to the bottles when they are wet.

- **Chlorophyll-a Sampling:** When collecting the chlorophyll-a sample using the composite method, please collect one Kemmerer bottle full of water ***at each meter from the middle of the metalimnion up to 1 meter from the surface.*** Please empty the water from each meter into a bucket and mix the sample. Fill the ***big brown bottle*** with composited water. The big brown opaque bottle must be used for the chlorophyll sample so that that the algae in the sample are not exposed to light after sample collection.

NOTES

- **Monitor's Note (6/26/03):** French Brook not running
  (7/25/03): Inlet and Outlet barely flowing- samples still obtained. Inlet turbid in all spots; sample still taken. Outlet slightly disturbed while taking sample.
  (8/28/03): All tributaries dry (not running)

- **Biologist's Note (6/26/03):** Chlorophyll-a sample was not a composite sample; therefore it was rejected for analysis.
  (7/25/03): It appears that the bottom may have been disturbed while sampling (high phosphorous and turbidity) or that internal phosphorous loading is occurring.
  (8/28/03): The total phosphorous level at the hypolimnion was found to be high. No conductivity result was obtained for the hypolimnion sample. Due to laboratory error, the sample was not Run for conductivity.

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, ARD-32, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/ard/ard-32.htm.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, *NHDES-WD 97-8*, NHDES Booklet, (603) 271-3503.

Camp Road Maintenance Manual: A Guide for Landowners. KennebecSoil and Water Conservation District, 1992, (207) 287-3901.

Comprehensive Shoreland Protection Act, RSA 483-B, *WD-SP-5,* NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-5.htm.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, WD-SP-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-1.htm

Impacts of Development Upon Stormwater Runoff, WD-WQE-7, NHDES Fact Sheet, (603) 271-3503, or www.des.state.nh.us/factsheets/wqe/wqe-7.htm

Iron Bacteria in Surface Water, *WD-BB-18*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-18.htm

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, *WD-BB-9*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

Sand Dumping - Beach Construction, *WD-BB-15*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

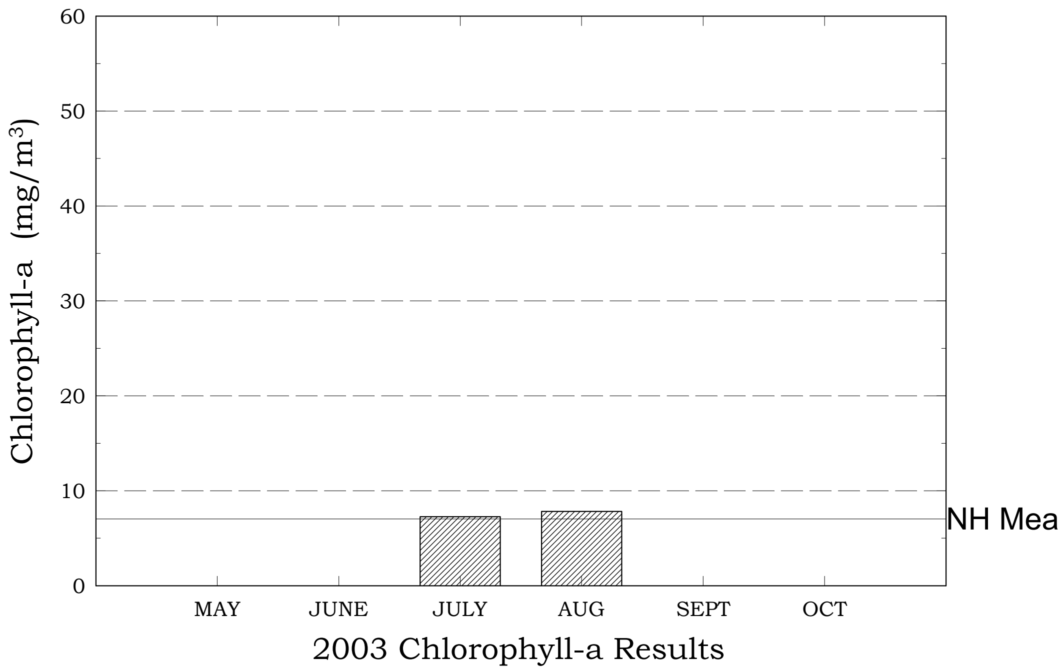
Through the Looking Glass: A Field Guide to Aquatic Plants. North American Lake Management Society, 1988, (608) 233-2836 or www.nalms.org.

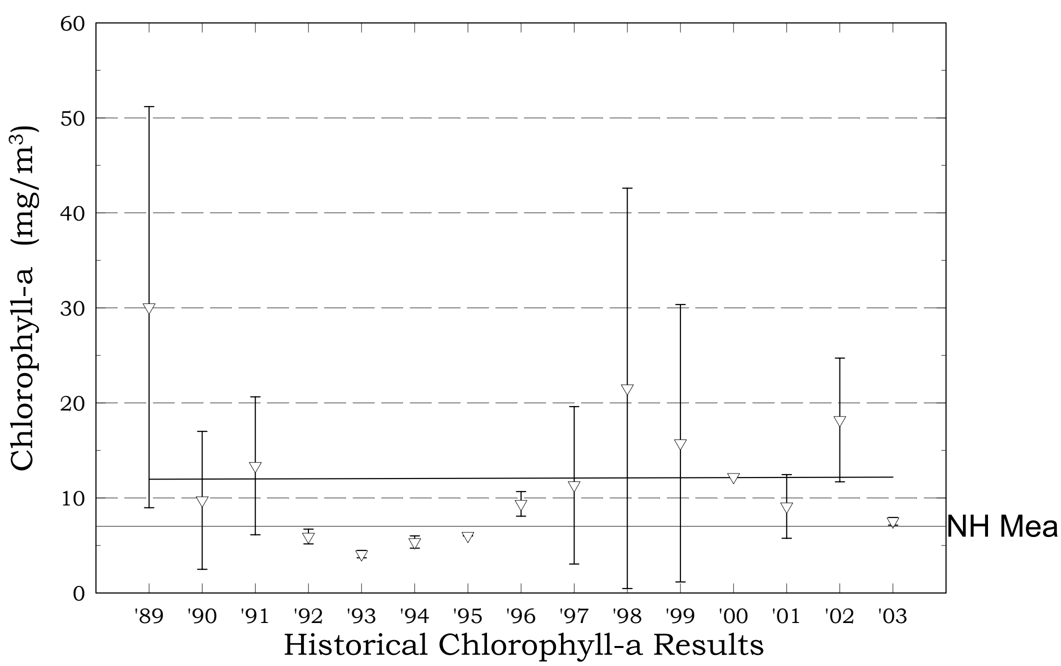
APPENDIX A

GRAPHS

French Pond, Henniker

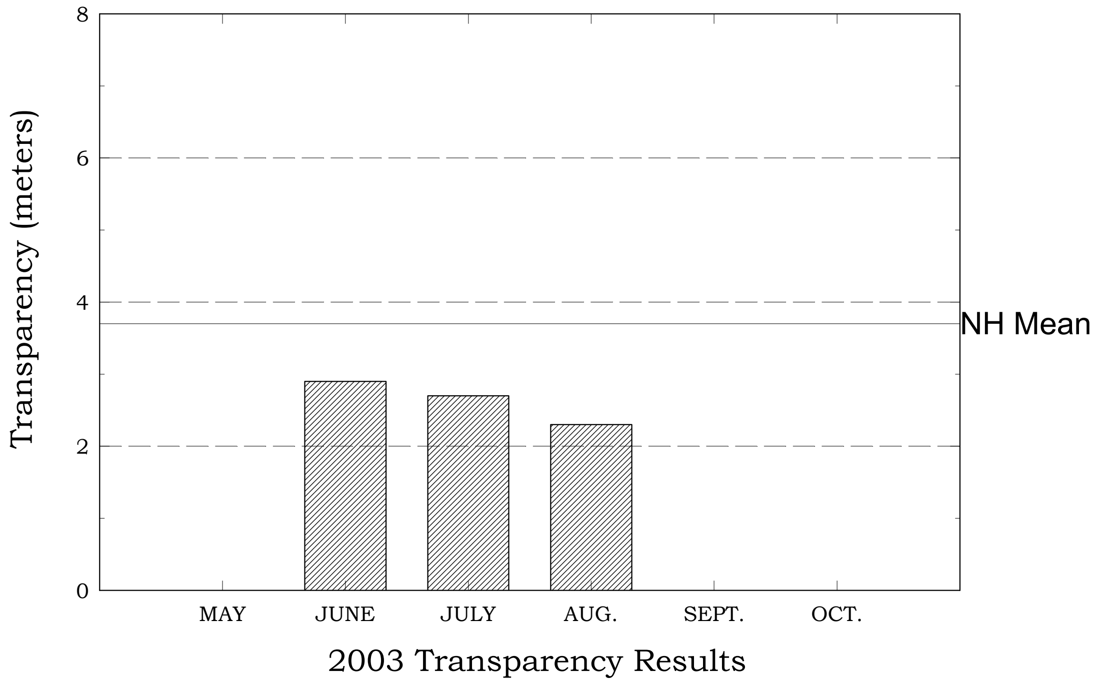
Figure 1. Monthly and Historical Chlorophyll-a Results

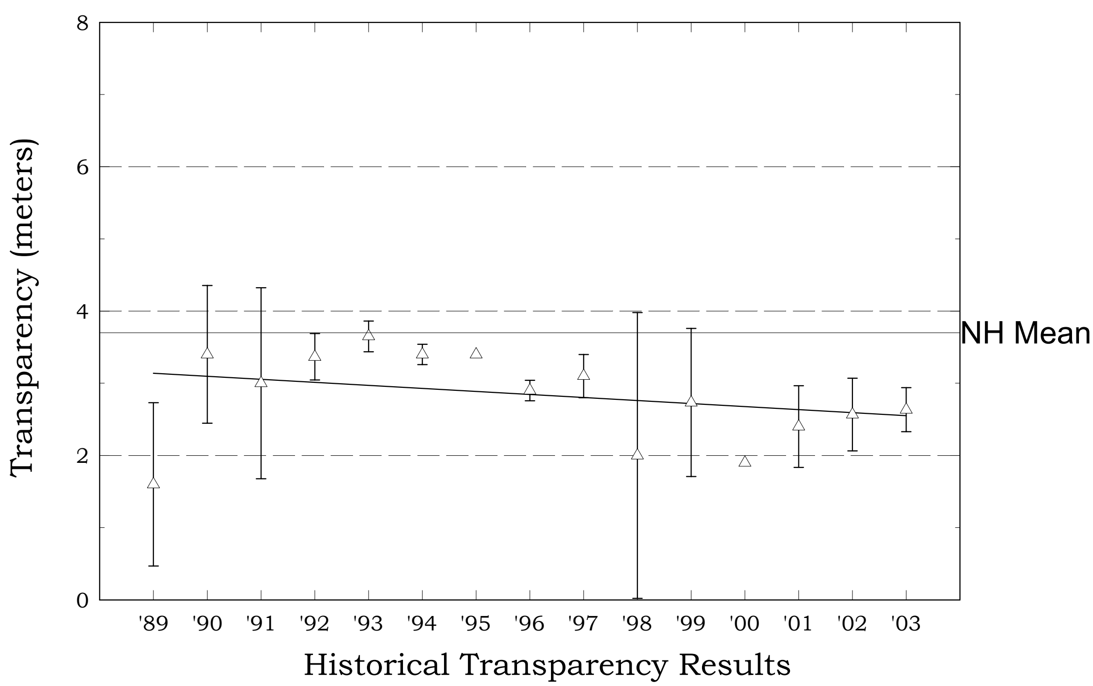




French Pond, Henniker

Figure 2. Monthly and Historical Transparency Results





French Pond, Henniker

Figure 3. Monthly and Historical Total Phosphorus Data.